DOCUMENT RESUME

ED 392 601 SE 057 700

AUTHOR Civil, Marta
TITLE Bringing the Mathematics to the Foreground. Draft.
SPONS AGENCY National Center for Research on Cultural Diversity and Second Language Learning, Santa Cruz, CA.; Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Apr 95
CONTRACT R117G10022
NOTE 22p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, April 1995).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Demonstration Programs; Elementary Secondary Education; *Mathematics Curriculum; *Mathematics Instruction; *Minority Group Children; Models

ABSTRACT

The goal of this paper is to explore possible explanations for why mathematics seems to remain in the background for many minority students. First, a brief background for a project to develop mathematics teaching that builds on students' backgrounds and experiences is provided. This is followed by a brief look at the theoretical framework supporting the project. Then, four learning modules are summarized and their mathematical potential as well as missed opportunities are discussed. Finally, a discussion of the difficulties in bringing mathematics to the foreground is given. Contains 45 references. (MKR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY
M. Civil

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED 392 601

Bringing the Mathematics to the Foreground

Marta Civil

Department of Mathematics
University of Arizona
Tucson, AZ. 85721

e-mail: civil@math.arizona.edu

DRAFT - DRAFT - DRAFT: COMMENTS ARE WELCOME!

Paper presented as part of a symposium entitled Contextualizing Mathematics and Bridging Cultures: Supporting Reform Mathematics Classrooms for Latino Students, at the Annual Meeting of the American Educational Research Association, San Francisco, April 1995.

The research reported here was funded in part by The National Center for Research on Cultural Diversity and Second Language Learning through the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education, under Cooperative Agreement No. R117G10022. The views expressed in this article are those of the author and do not necessarily reflect the views of the funding agencies.

CE 067 700

BEST COPY AVAILABLE

This paper presents my reflection on our recent work towards the development of teaching innovations in the mathematics education of minority students. Our goal is the development of mathematics teaching that builds on these students' backgrounds and experiences. Although we have evidence of children's positive affective and motivational reactions towards the learning modules, I am not so confident as to what kind of accomplishments we have made in terms of their learning of mathematics. The goal of this paper is to explore possible explanations for why, in my view, the mathematics seems to remain in the background. These explanations have to do with the different views on what mathematics is that the various people in the project have, as well as our goals, motivations and beliefs. In order to better understand what these differences may be, I found myself working on developing a clearer understanding of the theoretical underpinnings behind different views on education, particularly certain aspects of critical pedagogy. I will use this information as well as my current involvement in a different project to address the issues we are facing and offer some possible next steps. I first provide a brief background for the larger project, of which our work in mathematics is just a component. This is followed by a brief look at the theoretical framework supporting this research. Then, I summarize four learning modules and discuss their mathematical potential as well as missed opportunities. I conclude with a discussion of the difficulties in bringing mathematics to the foreground.

Background

The work presented here is part of a larger project --Funds of Knowledge for Teaching (Moll, 1992; Moll, Amanti, Neff, & González, 1992)--that has a primary goal the development of teaching innovations that build on the background, knowledge, and experiences of students and their families and community. It is a collaborative research project between university faculty and teachers working in schools where ethnic and language minority students are in fact the majority (primarily Mexican-Americans, some Yaqui Indians, and in one school, some African Americans, all schools are in working-class neighborhoods). The basic premise behind the teaching innovations is a rejection of the deficit model for the education of minority students.

> A critical assumption in our work is that educational institutions do not view working-class minority students as emerging from households rich in social and intellectual resources. Rather than focusing on the knowledge these students bring to school and using it as a foundation for learning, schools have emphasized what these students lack in terms of the forms of language and knowledge sanctioned by the schools. This emphasis on so-called disadvantages has provided justification for lowered academic expectations and inaccurate portrayals of these children and their families (González et al.,1993, pp. 1-2)

Instead, these teachers use a participatory approach to instruction in which students and often their family members take an active part in the development of learning modules. A key aspect of this project is hence to learn about these students' (and their families') knowledge, experiences, and skills (that is, what we refer as the "funds of knowledge"). The teachers do this via household visits to some of their students' homes. The teachers go in as learners to find out about the funds of knowledge in the household. They use questionnaires on the family structure, parental attitudes towards child-rearing, labor history, and household activities, as well as a child's questionnaire (to learn about his/her interests and participation in activities in the house, community). These questionnaires help teachers engage in a conversation with the family members (see González et al., 1993, for a detailed description of this process and for the teachers' perceptions).

I want to emphasize one key characteristic of these home visits with respect to the education of minority children. Our work in the Funds of Knowledge project is very localized. We often hear references to the education of Hispanic students, and wide generalizations that presumably characterize these "Hispanic" students. As Secada (1992) points out, there are wide distinctions among Hispanics, as they are among Mexican-Americans, as they are among any group. The home visits in our project allow us to learn about the cultural characteristics (where culture is understood as lived experiences) of these very specific people whom we visit. There are wide differences between, for example, recent Mexican immigrants whose children were born in Mexico and may have been here for two, three years, maybe less, and families who have been here for one generation or more. The home visits allow us to go beyond the often simplistic characterization of a certain group (in this case "Mexican-Americans") that looks at what can easily be seen, such as type of food, folklore, way to dress, and ignores more hidden aspects (see Licón Khisty, 1994, for a discussion of surface culture and deep culture).

The findings of these household visits are then analyzed and discussed via study groups. These are after-school sessions in which teachers and university faculty come together to brainstorm and share ideas that can then be developed into learning modules. Finally, a third component of the project is, of course, the classroom implementation, where the basic question is "how are the findings from the household visits and the ideas from the discussion groups being implemented in the classroom?" This third component is much of the focus of this paper since my main interest is in the students' learning of mathematics.

Theoretical Framework

In this section I outline very briefly the theoretical framework[1] that guides my thinking as I work with teachers in the project to develop teaching innovations in the mathematics classroom. The framework rests on three main bodies of literature:

[1] For an expanded version of this theoretical framework, see Civil, 1994, 1995.

- A sociocultural approach to instruction is at the basis of the larger project (Forman & Carr, 1992; Moll, 1992; Moll, Vélez-Ibáñez, Greenberg, et al., 1990). The classroom is seen as a potential learning community where its members contribute their expertise in different areas and where learning takes place through exchange and cooperation.

- Research on the development of classroom communities where mathematics is socially constructed (Cobb, 1991; Lampert, 1986, 1988; Schoenfeld, 1991). These classroom communities are often characterized by students engaging in mathematical discussions on open ended problems. Communication and negotiation of meanings are at the heart of what it means to do mathematics in these classrooms.

- Research documenting the gap between in-school and out-of-school mathematics (Bishop & Abreu, 1991; Brown, Collins, & Duguid, 1989; Carraher, Carraher, & Schliemann, 1985; Carraher, Schliemann, Carraher, 1988; Lave, 1988; Nunes, 1992; Resnick, 1987; Saxe, 1988; Schliemann, 1984; Schoenfeld, 1987, 1991). Many of these studies document how successful and resourceful people are at inventing their own methods of solution to tackle tasks that they see as relevant in their everyday life. Yet, some of these studies also document a lower performance once a "similar" task is presented in a school context.

The principles guiding the development of teaching innovations in the larger project are in alignment with what I view as necessary principles in the development of mathematics learning communities that reflect the recent call for reform (NCTM, 1989; NRC, 1989). For example, here are some of these principles (Moll, Vélez-Ibáñez, Greenberg, et al., 1990)

- Use of academically challenging activities.

- All students can be learners.

- The goal of reading and writing is the making of meaning [and, I will add, this should be the goal of mathematics too].

- The materials in a classroom must be meaningful and relevant.

- Consider the students' and their families' funds of knowledge as the bases for instruction.

In addition, the third body of research (on everyday mathematics) is particularly relevant for this project since, as the household visits have revealed, many of these students are often quite resourceful and given considerable responsibility for the functioning of the household (e.g., taking care of younger siblings, help with household chores, maintenance of appliances, ...). As a teacher mentioned "it was not until I went into their homes that I saw the potential and expertise that each child had to contribute to projects and studies that we did in the class" (González, et. al, 1993, p. 17). Yet, in school, these same children often do not perform well in academic subjects. Why is a student who while in Mexico had his own set of customers from the bakery that his parents managed, and hence dealt with orders and monetary decisions, doing rather poorly in school now? There are probably several reasons for this gap in the level of

functioning in what often are for these students two very different worlds. Can we develop learning modules that tap on these students' areas of expertise and yet help them advance in their learning of mathematics? The theoretical framework that I have briefly presented provides the basis for what we wanted to do in terms of teaching innovation in mathematics, namely to develop a mathematics classroom community that builds upon the children's resources and experiences and makes them active participants in their learning of mathematics. However, as the paper will illustrate, bringing the mathematics to the foreground seems to be rather elusive. In order to try to understand the reasons behind this elusiveness, I found myself looking at the broader picture of minority education and reading about the need to put mathematics in the context of political and social issues that are present (though often ignored) in schools (Frankenstein & Powell, 1994; Mellin-Olsen, 1987; Noddings,1993, 1994). What we view as doing mathematics remains the key question as our views will clearly affect whether we think that students were doing mathematics in the learning modules that I present in the next section.

Sample Learning Modules

The Candy Module

This module was developed by a sixth grade teacher before I joined the project. Even though I was not involved in its development, I would like to summarize it here because it not only captures all the key features of a learning module, but it is also a prototype of a mathematically rich module. My summary is based mostly on the teacher's report (Amanti, 1991) and on conversations with project staff. The module emerged from this teacher's home visits as she noticed that her student was involved in a transaction in which he was selling Mexican candy to one of his neighbors. Since this school has a large student population from Mexico, it is quite normal for many of the students to go across the border during weekends and vacations to visit relatives. While in Mexico, they purchase candy that they then sell to their friends and neighbors back in the U.S. As this teacher talked to other teachers in the school , she realized that the theme of Mexican candy was quite widespread in this school. One could say that knowledge about different types of Mexican candy and buying and selling price were part of the funds of knowledge of this school. The teacher then decided to develop a learning module around the theme of candy. This module would encompass health and social issues as they compared U.S. and Mexican candy, marketing, food production (see Amanti, 1991, for a detailed description of the different stages in the module, since here I will only highlight the mathematical aspects). The students devised a class survey on favorite candy; they then used graphs to display the results. One the questions the students were interested in pursuing (they had come up with the questions themselves) was "what ingredients are used in the making of candy?" This led to a discussion of how to go about addressing this question, for example, how many types of candy should they consider in order to be satisfied with their study of this question? The issue of appropriate

sample size was then addressed. The students settled on 20 different kinds of candy and proceeded to find out the ingredients, graph them and report their findings. The students kept two different lists, one for Mexican candy and one of U.S. candy. This led to a discussion on differences in the production of candy in these two countries. The culminating activity in this module was the visit by a parent who taught the class how to make one kind of Mexican candy. The class decided to have a candy sale. This meant designing and making packaging and labels, as well as posters for the candy sale. It also meant deciding on the sale price for the candy, taking into account the cost of the ingredients and desirable profit. Besides the actual opportunities for academic learning in this module, the teacher remarks on the high level of participation, interest and respect (especially when the student's mother came to show them how to make candy) that the children showed during the whole module, as well as the wealth of information that the children brought to the discussion.

The Money Module[2]

During one of her home visits, a fifth grade teacher learns about her student's interest in collecting coins. In talking about this visit in the study group session, she decides that she would like to develop a module around the theme of money. A third grade teacher at that same school and also a participant in the project then mentions that one of the families she has visited used to own a store in Mexico. The two teachers decide to collaborate and develop a learning module around the theme of money that will involve their two classes. They decide that they would like their module to integrate social studies, literature, and mathematics. As the three of us met to keep planning for the module, some of the mathematical ideas that came up were:

- Start with the students' familiarity with money to further their learning of whole number arithmetic (for the third graders), work with decimal numbers (fifth graders).

- Use the context of money for problem-solving situations.

- Building on the fact that many of these students are familiar with two kinds of currency (US and Mexico), develop exchange currency situations. Create a currency for each of the two classrooms, make products to sell ("cascarones" in the fifth grade class; paper flowers in the third class) and have a commercial exchange between the two classrooms.

- Work on ratio and proportion situations; price comparison.

What did happen. The two teachers started the discussion in their classrooms by eliciting students' knowledge about money. In the third grade class this was done through a concept web and in the fifth grade class through a two-column format (what we know; what we want to know). Although a main objective of this module was to explore the possibility of incorporating mathematics to a learning module, the reality was that:

---

[2] See Civil, 1992, for a more detailed description of this module.

- In the fifth grade class, most of the time was spent on students working on their research topic (selected from the "what we want to know" column). Hence, social studies, writing, reading were the main academic areas emphasized.

- In the third grade class, mathematics was present in a variety of forms, for example through connections to children's literature that has money as the focus. The book Dollars and Cents for Harriet by B. and G. Maestro, led to students comparing prices of kites and other objects that they were familiar with. The teacher used this to introduce the use of the symbols < and >. The students worked on problem-solving situations such as:

> The Math-a-thon was a success! The students collected $2,250.00. Make a table to show how many books we can buy if we pay $1.00 per book, $2.00 per book, and $5.00 per book.

But even in this class, I think that we only scratched the surface of the mathematical potential in a module around money. Why?

- This module took part towards the end of the school year; constant "distractions" (field trips; going to the auditorium to see a play, a dance, a concert; testing; half-days) that seem to characterize school life but that become more conspicuous as the end approaches, made us constantly revise our plans.

- But perhaps the main reason for so little mathematics in the module was lack of time and our lack of experience working together. A key aspect of the development of learning modules in this project seems to be to start with the children's ideas and knowledge and build from there. This strategy has worked well for the teachers in the project to encourage writing and reading starting with topics that the students are interested in. In fact, this was the case in the fifth grade class: the students took very seriously their research projects on themes such as Money, Power, and Politics; Foreign currency; How our money is spent--budgets. We would like to bring in the mathematics as we see it relevant to what the students are working on. This involves constant planning and revising of our agenda as we go, which is hard to do, especially given the little time that teachers have to do planning during their everyday routine (see Henderson & Landesman, 1992, for similar observations). Our lack of experience working together meant a constant exploration for what our different ideas and goals may be in learning mathematics. For example, I may think that presenting the students with problem-solving situations involving looking for combinations of coins is a valid mathematical experience. But the teachers may think otherwise, either because in this activity there is not a real connection to the home knowledge, or because they feel that other aspects of the mathematics curriculum for these grades should be emphasized. This is a collaboration project between the teachers and university faculty. I do not feel comfortable presenting them with a plan of action. The fact that most of the teachers in the project feel more comfortable and/or have more expertise in the literacy area than in mathematics

is a key point. As the third grade teacher said in one of our study group sessions, "I know how to let my students play with language, but I don't know how to let them play with mathematics." Her comment came up after I was presenting to them the parallels that I saw between how they approach their students' learning of literacy--namely, through inquiry, discussions, writing-- and how I thought we could approach the learning of mathematics. But I think that in order to make this a truly collaborative effort, the teachers have to have a chance to experience for themselves what "playing with mathematics" may be like. Opportunities for engaging students in writing may be much easier to find than opportunities for engaging them in doing mathematics. Although "superficial" uses of mathematics may be easily available (counting, measuring, simple arithmetic...), other features of mathematics, such as reasoning, abstracting, generalizing, using the language of mathematics, may be more elusive and hard to make them emerge from the context.

The Construction Module

This module captures a very careful effort at preparing possibilities for the learning of mathematics around the theme of construction. We started the planning during the summer prior to the implementation. The teacher, a project researcher, and myself met several times to brainstorm over the module. The teacher had had these students as first graders and was going to stay with them in second grade. Hence, she had already had a chance to uncover some of the funds of knowledge present in her class. She wanted to develop a learning module around construction because this was a topic that her students' families seemed to know a lot about. This teacher was quite experienced with the development of learning modules since she had participated in a prior stage of the project where she had developed a learning module around medicinal plants. Her whole teaching followed a thematic approach.

Her goals for mathematics in the construction module were:

- To develop students' awareness for different shapes, for example by looking at shapes used in building different houses.

- To work on measurement (including perimeter, area, and volume), by measuring bricks, amount of "paint" for a house on a geoboard; making adobe bricks; use of standard and non-standard units of measurement.

- To work on estimation, for example by estimating the number of bricks on the classroom's outside wall, and then determining how we can find out how many bricks were used.

- To continue working on patterning by looking at tiling patterns and creating their own patterns with pattern blocks, beads, cubes, keys, pebbles.

All these goals were met throughout the module. The students were thoroughly engaged in the learning module; they brought things from home (tools, bricks, parents' answers to questions about construction) related to the module. Arithmetic was used in context and I witnessed

children coming up with a variety of different ways to add and subtract. The measuring activities led to some of the difficulties that children this age encounter when using a ruler (such as where to start reading and how to read a result that does not end in a whole number). Since these students were used to working with each other and to contrast ideas, they naturally engaged in dialogues about their different interpretations on how to use the ruler. As one boy was measuring a brick with paper clips, he counted up to seven, and when I was expecting him to say "seven and a half" for the length, he said "six and a half." This led to conversation between him, his partner and myself in which I was trying to find out about their understanding of ordering numbers such as 6.5, 7, and 7.5 by talking about ages and whether a 6 and a half years old was older or younger than a 7 years old. On another occasion, I spent quite some time with two girls as we tried to determine the area (as number of cans of paint) of their house on the geoboard. My point is that whoever had entered that room during the "math time" (or any time, in terms of students' engagement in work) would have seen children engaged in a variety of mathematics activities related to the teacher's goals given earlier. They were either constructing something, or trying to guess someone else's pattern, or working on a problem, or talking to their partner about the task, or writing in their mathematics journal. These children were persistent and eager to explore a question, engage in conversation about their work with me or any other adult who visited the classroom.

Yet, I am still struggling with how to document and assess what it is that these students learned in mathematics. The teacher feels comfortable with the experience and believes that this approach is the way to go. She has certainly seen very high gains in the affective domain in terms of students' attitudes towards schooling: her students are hardly ever absent, seem happy to be in the classroom, are alert, motivated, and excited about learning. This teacher has also established a very good rapport with her students' parents. This rapport probably accounts for the perfect return rate she received from a school wide survey in which parents were asked for their perceptions on the mathematics program. For this teacher, mathematics has to be integrated throughout (as any other academic subject). In fact, this is how she talks about mathematics:

> I think that's what the whole project is about, making them realize that there is a lot that they know about mathematics already, everything you do is mathematics, math is not this worksheet they give you, ... I think in the past we thought of mathematics as being formulas and you know, lots of numbers in a written form, and now, my concept of mathematics is totally different, it's meaning, to me, it's finding meaning to why some things work and it doesn't necessarily have to be in numbers, it can be in written language, in literature, [pause] I don't know, just finding out why something works, that's how I see mathematics; and I think that's where they were at, I think that if we start looking for that, if we start looking to see if they are making meaning out of what they're doing, building, making, that's mathematics. (Interview, P.T.S., 1993)

This teacher wants her students to have ownership of their learning. Especially in the development of the construction module, a key issue was that the opportunities for mathematical exploration had to arise from the children's and their families' experiences. This is consistent with her view that "there is a lot that they know about mathematics, everything you do is mathematics," as her quote above shows. However, she was very aware of where these students were going next. This school is K-2. For grades 3 to 5 these students go to a more traditional school, certainly one that has not embraced the funds of knowledge approach (and from what I have heard and seen, one in which some teachers appear to lean towards the deficit model of education for minority students). This creates serious problems as these students are, for example, expected to know the traditional algorithms for addition and subtraction when they reach third grade. This teacher was then caught between what she believes is appropriate and educationally sound for her students and her need to help them function in a different environment. She was aware of this and would alternate thematic teaching with traditional, pencil and paper mathematics teaching. But she often expressed her frustration when she saw very capable children performing rather poorly when trying to do the traditional algorithms in a worksheet context.

My frustration stems from the fact that I am not quite sure how to determine what it is that these students learned in mathematics. Sure, they were engaged, persistent and curious; they were talking in a mathematics context and indeed developing certain rules of the discourse in this discipline. Maybe, my hesitations are the result of my content orientation. For example, I would have liked to see how they tackled problem-solving type situations, investigations in mathematics. The teacher and I talked about this, but my impression at the time was that she viewed these mathematics tasks as artificial and removed from the children's experiences.

Focusing on Mathematics: Our Recent Work in a Fifth Grade Class

Our original idea was to develop learning modules based on the funds of knowledge uncovered through home visits but with a focus on mathematics. In the next section I will suggest some possible next steps that we could take to make this happen. In this section I want to briefly describe a switch in our approach and the reasons for it. For the last two years I have been collaborating with one of the project teachers whose primary goal was to work on developing a mathematics teaching innovation (see Civil, 1994; 1995; Civil & Andrade, 1995 for descriptions of this work). Here, I will just refer to our work during the 1993-94 school year, in her fifth grade classroom. First of all, our work became an intense collaboration between the teacher, a research associate, and myself. The research associate interviewed every children with the goal of uncovering children's funds of knowledge. The three of us met regularly and talked about how to bring change to the mathematics classroom. I regularly taught (or co-taught) in her classroom and was there two to three days a week. We engaged the students in the kinds of

mathematics experiences that are recommended by professional organizations (NCTM, 1989; NRC, 1989). What we did use from the Funds of Knowledge project was an emphasis on inquiry-based learning and on a participatory approach to instruction. We also tried to make connections between the activities in mathematics and the children's interests (as revealed through the interviews and conversations with them). We did develop a learning module around the theme of games. The teacher was interested in this theme because she felt that it would allow her to build on children's knowledge and interest in games. I was interested in it because of the mathematical opportunities embedded in many games. The children did indeed like this theme, especially the idea of making their own game to then show it to their parents (at parents night) and to the fourth grade class. As I describe elsewhere (Civil, 1994) the games the children made did not have as much mathematics as I was hoping for. But in this module, rather than letting them design their games right away, we spent quite some time doing mathematics through games. So, in this sense, I feel that our academic agenda was served. For example, we looked at patterns and generalization through the game of NIM; we explored probability through a variety of chance games. Sure, our idea behind exposing the children to these mathematically rich games was that they may take some of the mathematics ideas and use these to develop their own games. Although a few did some of that, most of them developed games that modeled games they were familiar with or that reflected their own interests.

Hoping for the mathematics to emerge may lead to no mathematics at all or no advancement in the students' learning of mathematics. This teacher and I are quite content oriented. In addition, we had collaborated for two years prior to this one and a constant feature in our dialogues was "there is not enough mathematics; where is the mathematics?" Hence, we opted for an approach that would capitalize on the mathematics while trying to bridge to the children's experiences. In fact, pushing even further our interest in capitalizing on the mathematics led us to develop a whole theme around geometry, right after we completed the games module. In this theme on geometry, we made connections to the students' awareness of geometry in their environment, we built on their ideas on how to approach the tasks, but our main goal was to advance their learning of mathematics (see Civil, 1995, for a description of some of this work).

Discussion

In looking back at all the modules that, in principle, were to incorporate mathematics, two questions always come to my mind:

1) Did the students advance in their learning of mathematics? That is, if students use mathematics as part of the module, are they learning anything new or are they mostly using that which they already knew? I am currently involved in a teacher enhancement project for mathematics. In a recent staff meeting, one of the staff members expressed her concern as to how in elementary school the increasingly popular use of integrated units provides students with

a "watered down" mathematics. Another staff member then added, "yes, if they've read a graph, they've done the math today." And this is particularly concerning as we move up the grades. The fact that second graders in the construction module were involved in measuring activities was probably appropriate and allowed them to advance in their learning. In fact, in an interview later that year, the teacher mentioned how the children had used a lot of their knowledge of measurement acquired in the construction module for another theme around prehistoric animals (to discuss sizes and in the making of scale models). But if students in grades five or up use arithmetic as part of their project, or finds the perimeter of a room, or a piece of land, are they learning any new mathematics? Sure, they are seeing how the mathematics they know can be used in the completion of their task. There is certainly a lot of value to this, I think. But, I do think that one of the goals of in-school mathematics should be to give students a taste for the bigger picture of what doing mathematics is, beyond the everyday uses that most of us make of mathematics.

2) Do students view the mathematics embedded in the modules as "real" mathematics? Once again, this question may be more relevant as we move up in the grades. By fifth grade students have developed an idea of what school mathematics looks like. In our work in the modules, some students questioned whether what we were doing was mathematics. This is not unique to a thematic approach to learning. We are seeing a similar reaction among students in some of the classrooms of our current project: as teachers move away from traditional approaches to the teaching of mathematics, some students (especially in the upper grades) and parents wonder whether what we are offering them is mathematics. My concern with whether students view what they are doing as being mathematics has to do with issues of transfer and making connections. Unfortunately, in most cases, the funds of knowledge project is restricted to one or two teachers in one school. Thus, after one year in a classroom where teacher and students try to base the learning of mathematics (and of other subject areas) on their everyday experiences and knowledge, these students usually move to a very different kind of classroom for the next grade. Students may have indeed been involved in rich mathematical opportunities but if they do not see what they did as "school mathematics," or if the connections to what they may expect to see in the next grade are not made, are we helping these children?

In what follows, I suggest some possible next steps in our work in the Funds of Knowledge project to try to bring the mathematics to the foreground:

a) The home visits have been crucial in allowing the teachers to realize that many of the families they visit are very resourceful, knowledgeable, and concerned about their children's education. It had also allowed them to learn about how many of these children share in the responsibilities of the management of the household through chores, helping with siblings, small jobs. Some of the teachers have also been able to observe how their students (or their siblings)

learn how to perform certain tasks (e.g., cooking, welding, fixing cars) through a model that is very much like an apprenticeship, beginning with observation, and becoming progressively more actively involved.

These findings have influenced their perceptions of their students, their approach to teaching, and to a certain extent the content they teach. What is the potential of these home visits for bringing change to the mathematics learning of these children? We need to make home visits that capitalize on the "mathematics funds of knowledge." But at this stage, all we have is rather anecdotal, and I am not sure what such a direction would yield. I accompanied a teacher in one of her home visits to a Mexican family that had recently moved to the US. While in Mexico, this family managed a bakery. The son who was this teacher's student (9 years old) had his own set of customers to whom he sold bread at the end of his school day. He managed orders, receipts, prices, change. He was, according to his mother, quite resourceful and successful in his small business. How can we tap on this knowledge in school? A key issue that we are going to have to tackle in the home visits with a focus on mathematical opportunities is what it is that we count as mathematics. Bishop (1994) writes "Is there one mathematics appearing in different manifestations and symbolizations, or are there different mathematics being practised which have certain similarities?" (p. 15).

Another outcome of that home visit was that the teacher and I learned about what the mother thought about his son's school mathematics. The mother commented on the huge difference that she noticed in mathematics in school in Mexico versus here in the US. In Mexico, she said, they were doing much more arithmetic and in general she felt that the mathematics was more demanding. Both, teachers and parents have remarked that indeed quite often, recent Mexican immigrants are more proficient at computation than their US classmates. Parents need to be informed of our rationale in developing teaching innovations. Our current project reaffirms that, unfortunately, white, middle and upper class parents are often ready to voice their concern about some of the reform ideas, while we seldom hear from the parents in schools serving a majority of Hispanic and economically disadvantaged students. Home visits, such as envisioned by the Funds of Knowledge project have the potential to let us know about these parents' views on the mathematics their children are learning in school.

b) We need to focus on curriculum construction that capitalizes on mathematics. Although we have done some of that as part of our study group sessions, it is not clear what takes place in the classroom afterwards. One model that we have used on a few occasions and that I think has potential is that of a curriculum construction retreat. For two days, teachers first present some of their findings from the household visits and then suggest a learning module that they would like to develop based on their findings (e.g., clothing, farming, music, food, games). Then we all brainstorm and try to come up with academic possibilities for each module. For example, what

mathematics can they learn in a module around clothing? Although on paper we came up with quite a few ideas, what takes place in the actual classroom is a different story. The reasons for this are complex:

i) How far can we push the potential of these mathematical "snippets" in a module? For example, patterning was suggested as part of the clothing module. But how is this going to take place? Are the children (this was to be implemented in a fifth grade class) going to look for patterns in clothing? If so, for what purpose? What are they learning? This is, I think, the key question we are facing. In my opinion, for most cases we do not have a clear way to assess what mathematics students are learning.

ii) Different teachers take the modules in different directions. Some want to follow their students' interests to the expense of their own agenda. Others may be more interested in aspects of literacy than of mathematics. Teachers play a crucial role in this project; I return to them later.

The brainstorming session by itself is often not enough. The reason why I think that the construction module was quite successful is because of the immense amount of planning and discussion time that went along with the module. We started our work on the module the summer before. Those meetings were intense. Then, once the school year started, we were constantly revising plans as the module evolved. In addition, the teacher was very experienced with the Funds of Knowledge approach and had had these students since the year before. I was in her classroom very often and hence she had someone to bounce off ideas about mathematics. Unfortunately, we cannot do this with all the teachers in the project, which brings me to the third and last step that we need to work on if we are going to bring mathematics to the foreground in the project.

c) Teachers need to engage in doing mathematics themselves. This is a very hard point and yet it may be the most crucial. It is particularly hard right now because of all the different forms that the reform movement in mathematics education can take. Many of the teachers in the Funds of Knowledge project do take part in inservice sessions for mathematics (organized by the Title I program). Those workshops emphasize meaning construction, discussion of mathematically rich situations, integration across the curriculum. The mathematics program advocated in these sessions is by enlarge quite sound (from my perspective (and hence my set of values and beliefs) as a mathematics educator). It is a program that reflects many of the characteristics of a mathematics classroom community. Hence, the tasks often reflect the values of the culture of mathematics (Heckman & Weissglass, 1994). Although the tasks attempt to make connections to students' lives, these are somewhat superficial or contrived. What we are missing then in our project is teachers engaging in mathematics that does connect with their students' life experiences. We need to develop an image of what a mathematics program grounded on the funds of knowledge may look like. Using a format similar to the study groups, a next step

would be to concentrate on an exploration of mathematical ideas that emerge from the teachers' findings about their students and their families.

Henderson and Landesman, 1992, in referring to their experiences with a thematic approach to mathematics instruction for minority middle school students, write:

> We think it would be especially difficult for teachers with a superficial grasp of mathematics to recognize the opportunities to incorporate important mathematical concepts and problem solving into a theme (p. 12).

In a sense we are struggling with this in our project. Unless we have a clearer picture of the mathematical opportunities in a module and on how to push for these, the modules risk to present only surface applications of mathematics, often not challenging enough for the students. But, I think that in our project we are struggling with a different issue, too. This has to do with the differing views on what should this educational experience for minority students look like. This brings me to the last section in this paper.

What /Whose Mathematics is Not Being Brought to the Foreground?

Secada (1989), writes "how should we educate individuals from groups that have suffered discrimination to live in a world in which they are likely to be subjected to similar treatment?" (p. 46). I think that this question is crucial for many of the teachers and staff in the project. The pedagogical orientation in our project is to develop a participatory approach to teaching that capitalizes on children's knowledge and experiences, and that in fact makes them (and their families) co-constructors of the curriculum. As Connell (1994) writes, "To teach well in disadvantaged schools requires a shift in pedagogy and in the way the content is determined. A shift towards more negotiated curriculum and more participatory classroom practice..." (p. 137). We reject traditional approaches to education, particularly minority education because these tend to present decontextualized tasks that do not reflect their students' life experiences. In addition, for minority students, traditional approaches tend to advocate repetition and basic skills rather than academically challenging programs (Porter, 1990). These teachers are concerned about issues of equity and oppression and want to develop a learning environment that not only validates their students' knowledge but allows them to grow and hopefully allows them to break out of the cycle that Secada's quote implies. Hence, several of them find a great affinity with the proposals in critical education. Skovsmose (1994) in an overview of critical education, and particularly of Freire's work, writes:

> *If education, as both a practice and a research, should be critical it must discuss basic conditions for obtaining knowledge, it must be aware of social problems, inequalities, suppression etc., and it must try to make education an active progressive social force.* [italics in text]... To be critical, education must react to social contradictions. (pp. 37-38)

What are the implications of a critical pedagogy for mathematics education? Several authors tackle this question (Apple, 1992; Frankenstein, 1989; Frankenstein & Powell, 1994; Mellin-

Olsen, 1987; Skovmose, 1994). Maybe in our study groups we need to engage in the approaches to mathematics advocated by these authors. We should look at what role mathematics plays in societal, political, economic decisions. The problems that we tackle should be socially relevant to our students' lives. I do not know where this would lead eventually. I am skeptical that we would see much of a discussion of what are considered to be sensitive issues such as differences in wages, welfare, free lunch program (all aspects of the reality of many of the students we work with in this project), even though Apple (1992) points out that "these kinds of problems would have been powerful ways of linking mathematics to the real world of those students who are least likely to succeed in school" (p. 424). Similarly, Secada (1989), writes:

> Whether a mathematics curriculum would actually attempt to confront such uses of mathematics is doubtful. Yet not doing so would represent two failures. It would restrict the contexts in which mathematics is portrayed as having legitimate uses. Secondly, it would fail to acknowledge the lived experiences of many students who should use mathematics. (pp. 49-50).

(For an example of an experience of critical pedagogy in a third grade class that does address some of these real world situations, see Skilton Sylvester, 1994.)

As part of the initial discussion of the Money module, two of the teachers in fact suggested the development of a simulated economy in which issues of pay inequity between professions and between men and women could be incorporated. Probably not many teachers in the project are ready to change their mathematics teaching to address social and political factors. But many, if not most of them, do question what and whose mathematics their students are supposed to learn. These teachers are well acquainted with the pervasive image of mathematics as being Eurocentric and a male domain (Frankenstein & Powell, 1994; Joseph, 1991). The notion of ethnomathematics is very attractive as it offers alternatives to "academic" mathematics. Household visits with a focus on mathematics may help us develop a body of ethnomathematics practices that these children may in fact be familiar with. However, this still does not solve the issue of what it is that we should be doing in the classroom, especially when we look at the larger picture of the overall academic life that these students have ahead of them. Connell (1994) writes "we can now see that the work of teachers in disadvantaged schools implies not a shift to different content (though there will be some of that), but, more decisively, a different organization of the field of knowledge as a whole" (p. 138). Bringing in the students' ethnomathematics may help bridge to the more "academic" content. As Knijnik (1993) writes, in the context of her research on one of Brazilian organized rural movements,

> Merely glorifying popular knowledge does not contribute to the process of social change. When a specific subordinate group becomes conscious of the economic, social, and political disadvantages which its scarce knowledge brings about, and tries to learn erudite knowledge, this type of consciousness may contribute to the process of social change (p. 25).

Although I do not agree with some of her choice of terms (particularly, "scarce knowledge"), reading this excerpt reinforces my belief that, unless we can change the whole education system that these children are going to go through, we need to make sure that we are preparing them to succeed in it, even though we may disagree with some (or most) of what takes place in it. In mathematics, this means an academically challenging program that does prepare them for the more formal and abstract aspects of mathematics.

References

Amanti, C. (1991). Taking advantage of student knowledge. Unpublished manuscript.

Apple, M. W. (1992). Do the Standards go far enough? Power, policy, and practice in mathematics education. Journal for Research in Mathematics Education, 23, 412-431.

Bishop, A. (1985). The social construction of meaning-a significant development for mathematics education? For the Learning of Mathematics, 5 (1), 24-28.

Bishop, A. (1994). Cultural conflicts in mathematics education: Developing a research agenda. For the Learning of Mathematics, 14 (2), 15-18.

Bishop, A., & Abreu, G. (1991). Children's use of outside-school knowledge to solve mathematics problems in-school. In F. Furinghetti (Ed.), Proceedings of the Fifteenth International Conference for the Psychology of Mathematics Education (Vol. 1, pp. 128-135). Assisi, Italy.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18 (1), 32-42.

Carraher, T. N., Carraher, D. W., & Schliemann, A. D. (1985). Mathematics in the streets and in the schools. British Journal of Developmental Psychology, 3, 21-29.

Carraher, T.N., Schliemann, A.D., Carraher, D.W. (1988). Mathematical concepts in everyday life. In G.B. Saxe & M. Gearhart (Eds.), Children's Mathematics (pp. 71-87). San Francisco: Jossey-Bass.

Civil, M. (1992). Entering students households: Bridging the gap between out-of-school and in-school mathematics. In A. Weinzweig & A. Cirulis (Eds), Proceedings of the 44th International Meeting of ICSIMT (pp. 90-109), Chicago: ICSIMT.

Civil, M. (1994). What mathematics? Whose mathematics? A reflection on building on children's everyday experiences and "becoming mathematicians." Manuscript submitted for publication.

Civil, M. (1995, April). Everyday mathematics, "mathematicians' mathematics," and school mathematics: Can we (should we) bring these three cultures together?. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Civil, M., & Andrade, R. (1995). Rethinking Mathematics Learning: Using a Logo Environment to Create a Micro Mathematics Classroom Community. Manuscript submitted for publication.

Cobb, P. (1991). Reconstructing Elementary School Mathematics. Focus on Learning Problems in Mathematics, 13 (2), 3-32.

Connell, R. W. (1994). Poverty and education. Harvard Educational Review, 64, 125-149.

Forman, E. A., & Carr, N. (1992, April). Using peer collaboration to foster scientific thinking: What determines "success"?. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Frankenstein, M. (1989). Relearning mathematics: A different third R - radical maths. London: Free Association Books.

Frankenstein, M. & Powell, A. (1994). Toward liberatory mathematics: Paulo Freire's epistemology and ethnomathematics. In P. L McLaren & C. Lankshear (Eds.), Politics of liberation: Paths from Freire (pp. 74-99). New York: Routledge.

González, N., Moll, L., Floyd-Tenery, M., Rivera, A., Rendón, P., Gonzales, R., & Amanti, C. (1993). Teacher research on funds of knowledge: Learning from households. Santa Cruz, CA: University of California, National Center for Research on Cultural Diversity and Second Language Learning.

Heckman, P. E., & Weissglass, J. (1994). Contextualized mathematics instruction: Moving beyond recent proposals. For the Learning of Mathematics, 14 (1), 29-33.

Henderson, R. W., & Landesman, E. M. (1992). Mathematics and middle school students of Mexican descent: The effect of thematically integrated instruction. Santa Cruz, CA: University of California, National Center for Research on Cultural Diversity and Second Language Learning.

Joseph, G. (1991). Foundations of Eurocentrism in mathematics. In M. Harris (Ed.), Schools, Mathematics and Work (pp. 42-56). New York: Falmer.

Knijnik, G. (1993). An ethnomathematical approach in mathematical education: A matter of political power. For the Learning of Mathematics, 13 (2), 23-25.

Lampert, M. (1986). Knowing, doing, and teaching multiplication. Cognition and Instruction, 3, 305-342.

Lampert, M. (1988). The teacher's role in reinventing the meaning of mathematical knowing in the classroom. In M. J. Behr, C. B. Lacampagne, & M. M. Wheeler (Eds.), Proceedings of the Tenth Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 433-480). De Kalb, IL: Psychology of Mathematics Education.

Lave, J. (1988). Cognition in practice: Mind, mathematics, and culture in everyday life. New York: Cambridge University Press.

Licón Khisty, L. (1994). On the social psychology of mathematics instruction: Critical factors for an equity agenda. In J. P. da Ponte & J. F. Matos (Eds.), Proceedings of the Eighteenth International Conference for the Psychology of Mathematics Education (Vol. 3, pp. 89-96). Lisboa, Portugal.

Mellin-Olsen, S. (1987). The politics of mathematics education. Dordrecht, Netherlands: Kluwer.

Moll, L.C., Vélez-Ibáñez, C., & Greenberg, J., Whitmore, K., Saavedra, E., Dworin, J., and Andrade, R. (1990). Community knowledge and classroom practice: Combining resources for literacy instruction (OBEMLA Contract No. 300-87-0131). Tucson, AZ: University of Arizona, College of Education and Bureau of Applied Research in Anthropology.

Moll, L. (1992). Bilingual classroom studies and community analysis. Educational Researcher, 21 (2), 20-24.

Moll, L., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. Theory into Practice, 31, 132-141.

National Council of Teachers of Mathematics, Commission on Standards for School Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: The Council.

National Research Council (NRC). (1989). Everybody counts: A report to the nation on the future of mathematics education. Washington, DC: National Academy Press.

Noddings, N. (1993). Politicizing the mathematics classroom. In S. Restivo, J.P. Van Bendegem, & R. Fischer (Eds.), Math worlds: Philosophical and social studies of mathematics and mathematics education (pp. 150-161). Albany, NY: State University Press.

Noddings, N. (1994). Does everybody count? Reflections on reforms in school mathematics. Journal of Mathematical Behavior, 13, 89-104.

Nunes, T. (1992). Ethnomathematics and everyday cognition. In D. A. Grouws (ed.), Handbook of research on mathematics teaching and learning (pp. 557-574). New York: Macmillan.

Porter, A. (1990). Good teaching of worthwhile mathematics to disadvantaged students. In M. S. Knapp, & P.M. Shields (Eds.), Better schooling for the children of poverty: Alternatives to conventional wisdom (Vol. II, pp. V1-V22). Washington, DC: U.S. Department of Education. Office of Planning, Budget, & Evaluation.

Resnick, L. B. (1987). Learning in school and out. Educational Researcher, 16 (9), 13-20.

Saxe, G. B. (1988). Candy selling and math learning. Educational Researcher, 17 (6), 14-21.

Schliemann, A. D. (1984). Mathematics among carpentry apprentices: Implications for school teaching. In P. Damerow, M. E. Dunkley, B. F. Nebres, & B. Werry (Eds.), Mathematics for all (pp. 92-93). UNESCO.

Schoenfeld, A. H. (1987). What's all the fuss about metacognition?. In A. H. Schoenfeld (Ed.), Cognitive science and mathematics education (pp. 189-215). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schoenfeld, A. H. (1991). On mathematics as sense-making: An informal attack on the unfortunate divorce of formal and informal mathematics. In J. F. Voss, D. N. Perkins, & J. Segal (Eds.), Informal reasoning and instruction (pp. 311-343). Hillsdale, NJ: Lawrence Erlbaum.

Secada, W. (1989). Agenda setting, enlightened self-interest, and equity in mathematics education. Peabody Journal of Education, 66, 22-56.

Secada, W. (1992). Race, ethnicity, social class, language, and achievement in mathematics. In D. A. Grouws (ed.), Handbook of research on mathematics teaching and learning (pp. 623-660). New York: Macmillan.

Skilton Sylvester, P. (1994). Elementary school curricula and urban transformation. Harvard Educational Review, 64, 309-331.

Skovmose, O. (1994). Towards a critical mathematics education. Educational Studies in Mathematics, 27, 35-57.